SEXUAL MEDICINE REVIEWS

Feminizing Genital Gender-Confirmation Surgery

Miriam Hadj-Moussa, MD,[1] Dana A. Ohl, MD,[1] and William M. Kuzon Jr, MD, PhD[2]

ABSTRACT

Introduction: For many patients with gender dysphoria, gender-confirmation surgery (GCS) helps align their physical characteristics with their gender identity and is a fundamental element of comprehensive treatment. This article is the 2nd in a 3-part series about the treatment of gender dysphoria. Non-operative management was covered in part 1. This section begins broadly by reviewing surgical eligibility criteria, benefits of GCS, and factors associated with regret for transgender men and women. Then, the scope narrows to focus on aspects of feminizing genital GCS, including a discussion of vaginoplasty techniques, complications, and sexual function outcomes. Part 3 features operative considerations for masculinizing genital GCS.

Aim: To summarize the World Professional Association for Transgender Health's (WPATH) surgical eligibility criteria and describe how patients with gender dysphoria benefit from GCS, provide an overview of genital and non-genital feminizing gender-confirmation procedures, and review vaginoplasty techniques, preoperative considerations, complications, and outcomes.

Methods: A review of relevant literature through April 2017 was performed using PubMed.

Main Outcome Measures: Review of literature related to surgical eligibility criteria for GCS, benefits of GCS, and surgical considerations for feminizing genitoplasty.

Results: Most transgender men and women who satisfy WPATH eligibility criteria experience improved quality of life, overall happiness, and sexual function after GCS; regret is rare. Penile inversion vaginoplasty is the preferred technique for feminizing genital GCS according to most surgeons, including the authors whose surgical technique is described. Intestinal vaginoplasty is reserved for certain scenarios. After vaginoplasty most patients report overall high satisfaction with their sexual function even when complications occur, because most are minor and easily treatable.

Conclusion: GCS alleviates gender dysphoria for appropriately selected transgender men and women. Preoperative, intraoperative, and postoperative considerations of feminizing genital gender-confirmation procedures were reviewed. **Hadj-Moussa M, Ohl DA, Kuzon WM. Feminizing Genital Gender-Confirmation Surgery. Sex Med Rev 2018;XX:XXX–XXX.**

INTRODUCTION

Gender-confirmation surgery (GCS) is an effective and medically necessary treatment for many patients with gender dysphoria.[1] GCS enhances the benefits of psychotherapy, social transition, and hormone therapy to alleviate gender dysphoria by maximizing physical characteristics congruent with a patient's gender identity. Contemporary studies support that appropriately selected patients who undergo GCS experience relief from gender dysphoria and improved emotional well-being and quality of life (QOL).[1-3] Patients also benefit from a wide range of procedures to alter their secondary sex characteristics (Table 1).

This article is the 2nd in a 3-part series focused on the comprehensive treatment of gender dysphoria. In part 1, the diagnosis and non-operative management of gender dysphoria, including psychotherapy, social gender transition, and hormone therapy, were reviewed.[4] In part 2, surgical eligibility criteria, factors associated with regret, and benefits of GCS for transgender men and women are reviewed before focusing on feminizing gender-confirmation procedures, including an overview of genital and non-genital procedures, descriptions of vaginoplasty

Table 1. Gender-confirmation surgery

	Masculinizing surgery	Feminizing surgery
Face	Lipofilling	Facial feminization
	Liposuction	Thyroid chondroplasty
	Facial masculinization (rare)	Hair reconstruction
	Voice modification surgery (rare)	Voice modification surgery
Body	Subcutaneous mastectomy	Augmentation mammoplasty
	Male chest contouring	Lipofilling
	Pectoral implants	Gluteal augmentation
		Waist lipoplasty
Genital	Hysterectomy	Orchiectomy
	Salpingo-oophorectomy	Penectomy
	Vaginectomy	Vaginoplasty + clitoro-labioplasty
	Metoidioplasty ± urethral lengthening	Vulvoplasty + clitoro-labioplasty
	Phalloplasty ± urethral lengthening	
	Scrotoplasty	
	Testicular prosthesis placement	
	Penile prosthesis placement	

techniques, postoperative outcomes and complications, and the authors' operative technique for penile inversion vaginoplasty (PIV). Part 3 will focus on masculinizing GCS and review ancillary procedures and services that round out multidisciplinary treatment of gender dysphoria.

GENDER-CONFIRMATION SURGERY ELIGIBILITY CRITERIA

Health care professionals treating gender dysphoric patients are well advised to follow the Standard of Care (SOC) recommendations published by the World Professional Association for Transgender Health (WPATH), the pre-eminent professional organization dedicated to promoting high-quality evidence-based care for transgender patients.[1] The SOC establishes a framework for communication and interaction between the multidisciplinary and often geographically dispersed health care professionals caring for individual transgender patients. The WPATH's guidelines have been criticized for being rigid and paternalistic but that is not their intent. Rather than being interpreted as fixed "rules," the SOC explicitly states that interventions should be individualized for each patient and that deviation from the WPATH's recommendations is appropriate at times.[1] In addition, the SOC is under constant review and revised as knowledge and experience with this patient population grows; the 8th version of the SOC is currently being updated and has not been released.

A critical factor for high-quality transgender patient care is assessment by a mental health professional (MHP) who is knowledgeable about the assessment and treatment of gender dysphoria.[1] When a qualified MHP confirms a patient's readiness for GCS, the MHP can provide a referral to the appropriate surgeon. The WPATH SOC specifies that referrals for GCS from qualified MHPs should report the following[1]:

- Patient's gender dysphoria is persistent and well documented
- Patient has the capacity to make a fully informed decision and consent for treatment
- Patient is the legal age of majority in a given country
- Patient's medical or mental health comorbidities, including any psychiatric disorders, are "reasonably well controlled" (for chest surgery) or "well controlled" for genital surgery.[1] Obviously surgery should not be performed on actively psychotic patients.

The WPATH encourages individualized treatment based on each patient's specific goals for gender expression and thus does not specify which procedures should be done, or in what order.[1] Patients and their surgeons should come to a mutual agreement about which surgeries to perform, taking into account the patient's goals for GCS, realistic expectations regarding postoperative esthetic and functional outcomes, risk of morbidity, recovery times, and cost.

Non-Genital Surgery

The WPATH SOC does not require any letters of referral for facial feminization or masculinization procedures or for thyroid laryngoplasty. These procedures can be performed before, after, or independent of breast or chest or genital GCS.[1] To satisfy WPATH eligibility criteria for breast or chest GCS, patients should obtain 1 letter of referral from a qualified MHP.[1] Cross-sex hormone therapy is not a prerequisite for breast or chest surgery, although the WPATH encourages transgender women to be treated with at least 12 months of feminizing hormones before breast surgery because estrogen will stimulate breast development. In the authors' experience, many patients are satisfied with the breast size they achieve with estrogen therapy alone. Natural breast tissue also optimizes and stabilizes the postoperative cosmetic result for patients who opt to undergo breast augmentation surgery.[1]

Genital Surgery

WPATH eligibility criteria for genital GCS require 2 letters of referral from separate qualified MHPs and compliance, in the absence of a medical contraindication, with at least 12 months of continuous cross-sex hormone therapy.[1] Any patient undergoing metoidioplasty, phalloplasty, or vaginoplasty also must have completed a 12-month real-life social transition, living full time as their desired gender, to ensure they have resolved any personal, professional, or social issues surrounding their gender identity before undergoing irreversible genital surgery.[1] It should be noted that the 12-month real-life experience is the most heavily criticized stipulation of the SOC, viewed by some as a barrier to GCS. Psychotherapy is recommended but not required for patients undergoing genital GCS.

ROLE OF SURGEONS

GCS does not fall within a single specialty's scope of practice. Depending on the procedure and the surgeon's training and level of expertise, GCS is performed by plastic surgeons, urologists, general surgeons, otolaryngologists, and gynecologists. There is ongoing international discussion regarding the requisite training to perform GCS, especially genital procedures. Currently, there are very few residency training programs or fellowships that encompass GCS. In the absence of dedicated training curricula, board-certified surgeons intending to perform genital reconstruction should proceed with specialized training from experienced mentors.

Surgeons should confirm WPATH eligibility criteria have been met for each patient. This is ideally accomplished by maintaining a working relationship with other members of the patient's treatment team. GCS should be tailored to meet each patient's goals for gender expression so the WPATH recommends surgeons thoroughly discuss the options for each type of surgery with prospective patients including the benefits and drawbacks; realistic expectations for cosmetic and functional outcomes; financial obligations; and the risk of complications including how unsatisfactory outcomes are treated.[1] This information should be presented in advance of surgery, using layman's terms, and with the help of visual aids such as before and after photographs. Patients should be given a minimum of 24 hours to consider their options and have their questions answered before making the decision to proceed with surgery.[1] Informed consent must be documented for each procedure.

BENEFITS OF GENDER-CONFIRMATION SURGERY

Across all transgender health care research there is a paucity of high level-of-evidence studies. Reported case series are often from a single institution, samples are small, and reported outcome measures are inconsistent. Despite these limitations, the current body of published literature strongly suggests that most transgender patients who undergo GCS experience improved QOL, overall happiness, psychologic function, body image, and sexual satisfaction.[1,2,5–7]

A few higher-quality studies using validated QOL and patient-reported outcome measures are starting to be published. In 1 study 232 patients rated their QOL after GCS using a 21-point Likert scale ranging from −10 ("most worsening possible") to 10 ("most improvement possible) for an average score of 7.9 ± 2.6 (range = −2 to 10). The same cohort of patients rated their overall happiness with GCS with an average score of 8.7 ± 1.6 (range = 0–10).[8] In another study with a mean follow-up of almost 14 years, 68 patients rated their psychologic well-being after GCS from 1 ("worse than ever") to 5 ("better than ever") for an average score of 4.35 ± 0.86.[9] 96% of patients in a German study remarked that they would undergo GCS again.[10] Satisfaction with GCS remains high even when surgical complications occur, which likely reflects the importance of GCS for patients who above all are seeking relief from gender dysphoria.[8,9]

A small number of prospective studies measuring the impact of GCS also provide encouraging results. In a Brazilian study, 47 transgender men were evaluated before and 1 year after GCS using the World Health Organization Quality of Life Assessment (WHOQOL-100). Patients were found to have statistically significant improvements in psychologic (eg, positive feelings, self-esteem, body image) and social (eg, relationships, social support, sexual activity) domains. The same cohort did report worse physical health (pain and discomfort, energy and fatigue, sleep) and level of independence (mobility, activity of daily living), although the investigators suggested this finding could be related to the postoperative recovery period.[7] A prospective study of young transgender adults who underwent puberty suppression followed by cross-sex hormone therapy and GCS once they reached the age of consent showed that treatment was associated with statistically significant improvements in body image, psychological functioning, overall well-being, and decrease of gender dysphoria.[6]

Transgender patients describe their sexual function and sexual satisfaction, outcome measures associated with increased overall happiness and QOL, favorably after GCS.[2,5,8] After inversion vaginoplasty, transgender women in 1 study rated their sexual satisfaction with an average score of 7.8 ± 2.4 (range = 0–10).[8] In a retrospective study, trans-feminine and trans-masculine patients rated their postoperative sex lives on a scale from 1 ("very dissatisfied") to 5 ("very satisfied") for an average score of 3.42 ± 1.12 and 3.78 ± 1.07, respectively.[9] In a separate cohort of transgender men and women, 75.5% described an improved sex life after GCS, with some citing that they finally felt comfortable with their genitals.[5] Unfortunately, good postoperative sexual function is not ubiquitous; in the same study 12.3% of patients described worse sex lives after GCS because of genital pain, lack of sensation, and difficulty relaxing.[5]

REGRET AFTER GENDER-CONFIRMATION SURGERY

Regret after GCS is rare, occurring in 0% to 3.8% of patients.[9,11–13] Ongoing discrimination despite undergoing GCS can cause some patients to have difficulty expressing their

gender identity and regret having had surgery. Factors associated with regret include poor social and family support, late-onset gender transition, suboptimal cosmetic outcome, poor sexual function, concomitant mental health issues, and non-compliance with WPATH SOC guidelines.[11–14] In a study of patients requesting genital reversal surgery, Djordjevic et al[14] found that every patient had undergone GCS before meeting WPATH eligibility criteria by an insufficient social gender transition, absent or inappropriate hormone therapy, or evaluation by an improperly qualified MHP. Patterns that emerge from studies of regretful patients underscore the importance of adhering to WPATH SOC guidelines, which include rigorous training standards for MHPs who diagnose, treat, and refer gender dysphoric patients for GCS.[1]

FEMINIZING GENDER-CONFIRMATION SURGERY

Non-Genital Surgery

Non-genital procedures such as breast augmentation and facial feminization surgery can be particularly important interventions for transgender women, making it easier for them to present socially in a female gender role.[15] In fact, Ginsberg et al[16] found that facial procedures, including permanent hair removal and facial feminization surgery, were a priority over chest or genital surgery for most transgender women.

Facial Feminization, Thyroid Chondroplasty, and Voice Modification Surgery

Testosterone therapy can dramatically masculinize transgender men by leading to growth of facial and body hair, lowering vocal pitch, and increasing muscle mass. Unfortunately, feminizing hormone therapy does not alter the physical appearance of transgender women to nearly the same degree. As a result, facial feminization procedures are popular among transgender women and can include a combination of jaw and forehead contouring, rhinoplasty, chin reconstruction, scalp advancement, hair transplantation, and dermal filler injections.[17] Vocal cord surgery raises vocal pitch to traditionally feminine ranges and is usually performed with thyroid chondroplasty to reduce the thyroid cartilage (Adam's apple).[15]

Breast Surgery

Breast augmentation has been shown to increase feelings of femininity in transgender women.[17] Natural breast tissue optimizes the cosmetic result of breast augmentation, so the WPATH recommends patients be treated with a minimum of 12 months of feminizing hormone therapy before surgery.[1] Hormone therapy leads to variable breast growth. After 12 to 24 months of treatment many patients experience enough breast development that they choose to forgo augmentation.[1] Augmentation mammoplasty is performed using similar approaches as those used for ciswomen with a few additional considerations. The male chest is broad with a lower and more widely spaced nipple-areolar complex, so patients should be advised that these anatomic factors can limit implant choice. Achieving significant cleavage (medial breast fullness) is difficult because the implant must be centered under the nipple. Lipofilling (fat grafting) can be used for touchups and for primary breast enhancement when only a small augmentation is necessary.[17] The long-term outcomes and safety of lipofilling have not been studied in the transgender population.

Genital Surgery

As part of their gender transition, some transgender women elect to undergo genital GCS. Feminizing genitoplasty should be tailored to meet each patient's goals for her gender identity. At a minimum this involves bilateral orchiectomy to eliminate their major source of endogenous testosterone and decrease postoperative antiandrogen medication requirements. Full genital reconstruction with penectomy, urethroplasty, and vaginoplasty with clitoro-labioplasty represents the opposite end of the spectrum and aims to create a natural-appearing vulva, a neovagina with adequate width and depth for penetrative intercourse, and a sensate neoclitoris.[1,15,18,19] "Zero-depth" vaginoplasty (vulvoplasty with clitoro-labioplasty) is a good option for patients who are interested in having a feminine vulva and clitoris but who do not desire penetrative intercourse and/or want to avoid postoperative neovaginal dilation.

VAGINOPLASTY

Vaginoplasty techniques used during GCS have been adapted from procedures that were originally developed to treat vaginal agenesis.[19] Surgical creation of a neovagina has been described using different skin grafts, intestinal transposition, and pedicled genital or non-genital skin flaps. The optimal vaginoplasty approach has not been determined because large empiric studies directly comparing different procedures have not been performed. Nevertheless, PIV using a pedicled penoscrotal skin flap has emerged as the 1st-line approach for primary vaginoplasty according to most GCS surgeons including the authors whose surgical technique is described in Appendix A.[1,15,19]

Preoperative Considerations

General Considerations

Prospective surgical patients who have met WPATH SOC eligibility criteria should undergo a preoperative evaluation to assess their medical history, identify perioperative risk factors, and complete relevant diagnostic and laboratory testing.[20] Medical conditions should be reasonably well controlled. To optimize wound healing, diabetics should have well-controlled blood glucose with a hemoglobin A_{1c} level below 7%.[21] Smokers should quit at least 6 weeks before surgery; some surgeons perform preoperative urine cotinine testing as confirmation.[21] For any vaginoplasty procedure, prophylactic parenteral antibiotics appropriate for colorectal procedures should be administered within 60 minutes of incision.[22]

Table 2. Permanent hair removal for gender-confirmation surgery[23]

Electrolysis	Laser therapy
Mechanism of action	
An electrical current is transmitted through a small needle or probe to each hair follicle, permanently destroying it.	Laser light energy is absorbed by melanin in the hair shaft, damaging its follicle and decreasing the amount of hair that will grow. Different lasers are used based on hair color and skin type.
Advantages	
Hair follicles can be permanently destroyed	$60\times$ faster than electrolysis
Effective for light-colored hair	Requires fewer treatments
Each session less expensive	$3-6\times$ short sessions are repeated every 6 wk and completed 3 mo before surgery
	Large surface area treated each session
	Less painful, can pretreat with topical anesthetic
	Efficacy increased by shaving before treatment
	Very effective for dark-colored hair on light skin
Disadvantages	
Much slower than laser hair removal	Hair follicle is not permanently destroyed
Hair follicles are treated individually	Each session more expensive
Sessions last several hours and must be repeated every 1-2 wk for up to 1 y for full results	Not effective for light-colored hair
Results are highly variable and depend on the modality and operator	Must stop any hair removal (waxing, plucking, electrolysis) that damages the bulb for 4 wk before treatment
Painful, requires injected or topical anesthetic	Must strictly avoid sun exposure for ≥6 wk before and after treatment or risk dyspigmentation

Hair Removal

Permanent epilation of the external genitalia with laser therapy or electrolysis is strongly recommended to avoid lining the neovagina with hair-bearing skin, an outcome associated with lower patient satisfaction and potential complications.[8,23,24] Laser hair removal is more popular than electrolysis, but neither method permanently removes all hair and each is associated with advantages and disadvantages (Table 2).[23] There is some evidence that hair follicles regress over time, which could explain why regrowth after laser therapy or electrolysis tends to be sparse.[8,23] Hair removal can take 3 to 6 months and should be completed at least 2 weeks before vaginoplasty.[25]

Individual surgeons undoubtedly have their own protocols for hair removal, but few have been published in the literature. Hair should be removed from the entire penis and perineum plus any scrotal skin that will be used to line the neovaginal vault. This usually involves epilating the entire scrotum but hair removal from a midline strip of scrotal skin (4-10 cm) alone could be sufficient in certain situations.[23,26] Zhang et al[23] recommended patients bring photographs or diagrams from their surgeons that outline areas of hair needing removal to treatment sessions.

Some surgeons have advocated epilation at the time of surgery by aggressively thinning skin flaps to remove deep hair follicles. This practice has not been well studied, but 1st principle reasoning dictates that thinning a skin flap to the point of functioning like a full-thickness skin graft necessarily

compromises its blood supply and could increase the risk of wound complications. Furthermore, in the event a rectal perforation occurs during dissection of the neovaginal space, covering the repair with a well-vascularized skin flap is undoubtedly preferable to a poorly vascularized skin graft. Despite the time and expense required for preoperative hair removal, most GCS surgeons believe it adds a margin of safety and insist on its completion before surgery.

Bowel Preparation

A mechanical bowel preparation is recommended for all patients undergoing vaginoplasty. A bowel preparation increases the chance a rectal injury will heal after being repaired primarily instead of requiring a bowel diversion.[17,19,27,28]

Minimize Thromboembolic Risk

Estrogen is associated with an increased risk of thromboembolic events so most centers require it to be discontinued perioperatively, usually for at least 2 weeks before and 2 weeks after surgery.[1,18] Patients should be informed that they might experience hot flashes or mood swings during this time.[8] Smoking further increases the risk of venous thromboembolism for patients taking estrogen therapy, another reason patients should be required to quit smoking completely for at least 6 weeks before and after surgery.[1,18] Prophylactic heparin or low-molecular-weight heparin and pneumatic compression devices also are used intraoperatively and postoperatively by many surgeons.

Skin Graft Vaginoplasty

There are reports of vaginoplasty using genital or non-genital full- or split-thickness skin grafts to line the neovagina going back to the 1930s.[29] Skin grafts are not limited by a vascular pedicle, which ensures more can always be harvested to line the neovagina completely. The downside of a circumferential skin graft is that contraction leads to a cicatrix of scar tissue and introital or neovaginal stenosis in 33% to 45% of cases.[29,30] Undesirable scarring or hypopigmentation of donor skin sites and the lack of natural neovaginal lubrication are other drawbacks to this approach.[19] Despite their historical significance, primary vaginoplasty exclusively using skin grafts is seldom performed in contemporary practice because of these disadvantages.[30] Skin grafts are frequently used when there is insufficient tissue to create a neovagina with suitable depth for penetration from inversion of the penile skin alone.[19,31]

Intestinal Transposition Vaginoplasty

Pedicled rectosigmoid or ileal segments can be isolated through an open or minimally invasive approach, brought into the neovaginal space, and anastomosed with perineal skin create a functional neovagina.[15,17,30] Owing to the intrinsic properties of bowel mucosa, intestinal vaginoplasty produces a neovagina that has ample width and depth, is naturally lubricated with a texture similar to a biologic vagina, and requires less postoperative dilation to maintain its dimensions.[3,27] The benefits of intestinal vaginoplasty are mirrored by encouraging outcomes across functional, esthetic, and QOL measures.[32] Based on published data, intestinal vaginoplasty does not appear inferior to PIV in outcomes or complication rates.[30] Nevertheless, PIV remains the preferred approach for primary vaginoplasty for most GCS surgeons because intestinal transposition inherently involves an intra-abdominal operation and bowel anastomosis. Young transgender patients with penoscrotal hypoplasia after hormone-induced pubertal suppression are a notable exception. These patients might be ideal candidates for primary intestinal vaginoplasty because they have insufficient penoscrotal skin for PIV.[15] Intestinal vaginoplasty also is the preferred approach for salvage cases requiring secondary vaginoplasty.

The most commonly reported complication of intestinal vaginoplasty is introital stenosis, affecting 1.2% to 8.6% of patients.[15,30] Many cases can be treated with neovaginal dilation, although revision surgery might be required.[30] Excessive neovaginal discharge rarely lasts longer than 6 months but can be accompanied by malodor after up to 10% of rectosigmoid vaginoplasties.[27] Bowel complications, including diversion colitis, bowel obstruction, peritonitis, and adenocarcinomas, have been reported but are relatively uncommon.[27,30]

Penile Inversion Vaginoplasty

During PIV an anteriorly based inverted penile skin flap is combined with a 2nd posteriorly based perineal skin flap, which are primarily vascularized by internal pudendal artery branches, and used as a skin tube to line the neovagina.[33,34] PIV has many advantages and is the preferred approach for primary vaginoplasty in most scenarios. Penile skin is smooth, elastic, largely non-hair bearing, and contains minimal connective tissue.[15] Vascularized flaps are less likely to contract than skin grafts, so rates of neovaginal stricture and introital stenosis are lower and range from 1% to 12% and 2.5% to 15%, respectively.[15,17,21,30] Unlike intestinal transposition vaginoplasty, PIV does not require an intra-abdominal operation or bowel resection and eliminates the risk of malodorous neovaginal discharge, although it does require more postoperative dilation.[19]

The primary disadvantage of PIV is that there is a finite amount of penile skin to line the neovagina. Fortunately, the flap can easily be augmented with full-thickness skin grafts harvested from redundant scrotal skin excised during labioplasty, non-genital split-thickness skin grafts, or urethral flaps to create a neovagina of adequate depth.[30]

Clitoroplasty

The goal of clitoroplasty is the creation of an esthetically appealing neoclitoris with preserved erogenous sensitivity.[35] Several successful clitoroplasty techniques have been described, all using a vascularized segment of the dorsal glans penis innervated by the dorsal neurovascular bundle.[28] More than 80% of transgender women can achieve orgasm after clitoroplasty (range = 29–100%).[2,8,24,30,35–37]

Vulvoplasty

The labia majora and minora and clitoral hood are created during vulvoplasty. Labioplasty using a straightforward scrotal rearrangement yields the labia majora, its female embryologic equivalent, with excellent esthetic results. Labioplasty to create a feminine vulva can be performed in isolation for patients who do not desire a functional neovagina.[17] By contrast, creation of the labia minora has posed a challenge for surgeons. Its embryologic equivalent, the penile urethra, is amputated during penectomy so it cannot be used for reconstruction.[38] Several techniques to construct the labia minora have been described, with many surgeons gravitating toward the use of a penile shaft skin, a tradeoff that leaves less skin available to line the neovagina during PIV.[19,28,36,39–41] Penile shaft skin also is often used to create the clitoral hood in circumcised patients, in exchange for lining the neovagina. In uncircumcised patients, the prepuce can be used to form the clitoral hood, its female corollary.[38]

VAGINOPLASTY COMPLICATIONS

All major surgeries carry a risk of complications and feminizing GCS is no exception. Vaginoplasty requires disassembly, rearrangement, and reconstruction of multiple organ systems and thus is inherently associated with a diverse complication profile (Table 3). Patients considering vaginoplasty should understand

Table 3. Relative frequency of vaginoplasty complications[3,21,26,27,30,32,41–43]

	Frequency	Notes
Major systemic complications		
PE or DVT	<1%	
Stroke	Very rare	
Death	Very rare	
Genital complications		
Introital stenosis	Up to 15%	Increased risk if non-compliant with neovaginal dilation or sexually inactive
Neovaginal stenosis	<10%	Prevented and treated with neovaginal dilation
Malodorous discharge	<10%	Intestinal vaginoplasty, especially rectosigmoid
Neovaginal prolapse	<10%	Presents when neovaginal stent is removed; treat by reinsertion ± fibrin glue, bedrest; mucosal prolapse can be excised, secondary vaginopexy rarely necessary
Neovaginal mucosal bleeding	<10%	Intestinal vaginoplasty, especially rectosigmoid
Dyspareunia	<5%	Transient, lasting <6 mo
Neovaginal necrosis	<5%	Usually minor, after piv
Labial necrosis	<5%	Usually minor
Clitoral necrosis	<5%	Usually minor, erogenous sensation remains intact
Introital atresia	<3%	Treat with introitoplasty
Neovaginal atresia	<1%	Treat with secondary intestinal vaginoplasty
Rectovaginal fistula	<1%	Increased risk after rectal injury, secondary vaginoplasty
Neovaginal perforation	Very rare	
Urinary complications		
Misdirected urinary stream	Up to 40%	Tends to spray upward, treat with ventral meatoplasty
LUTS	Up to 20%	Most commonly urgency, frequency, and weak stream
Urinary incontinence	Up to 20%	Stress, urge, or mixed
Urinary retention	<15%	Postoperative and transient
Meatal stenosis	<10%	Treated with meatoplasty
Urethral injury	<5%	Intraoperative, can repair primarily + catheter drainage
Urinary tract infection	<5%	
Urethrovaginal fistula	<1%	Presents with continuous incontinence, recurrent UTI
Urethral necrosis	<1%	
Urethral prolapse	Very rare	
Wound complications		
Wound healing disorders	Up to 30%	Dehiscence, minor necrosis, or delayed wound healing; most are treated conservatively
Infection	Up to 20%	Increased risk with DM, history of drug use, anticoagulation
Unesthetic scar	Very rare	
Bleeding complications		
Postoperative hemorrhage	<10%	Most from corpus spongiosum; treat with placement of 22-Fr catheter or hemostatic suture placement (1–2%)
Blood transfusions	<5%	
Hematoma	<5%	Decreased risk with postoperative pressure dressing; can predispose for wound dehiscence; treat with expectant management, surgical intervention rarely required
Gastrointestinal complications		
Rectal injury (intraoperative)	<5%	Treat most with primary repair and low residue diet; bowel diversion rarely required
Ileus	<5%	
Peritonitis	<5%	
Bowel obstruction	<1%	50% will require bowel resection or lysis of adhesions
Diversion colitis	Very rare	
Neovaginal adenocarcinoma	Very rare	After intestinal vaginoplasty

DM = diabetes mellitus; DVT = deep vein thrombosis; LUTS = lower urinary tract symptoms; PE = pulmonary embolism; PIV = penile inversion vaginoplasty; UTI = urinary tract infection.

that complications are common. Life-threatening adverse events are rare and the risk of mortality is virtually 0%.[1,14,21] Patients also should be aware that 25% to 80% of patients undergo secondary procedures to optimize voiding or for vulvar cosmesis after vaginoplasty.[2,8,24,30,32,35–37] In this review the authors highlight certain common and/or major complications.

Intraoperative Complications

Serious intraoperative complications are uncommon. Rectal injuries sustained during dissection of the neovaginal space are the most frequently reported (0.45–4.5%).[21,30,41,42] Most can be repaired primarily with a 2-layer closure using absorbable suture. Bowel diversion is rarely necessary.[26] Most patients who sustain a rectal injury do not develop any long-term sequelae, although they are at greater risk of developing a rectovaginal fistula.[21,30,44] Urethral injuries occur in 0% to 4.0% of cases and can be repaired primarily with absorbable suture and prolonged catheter drainage.[21,30,45] Most groups report sporadic intraoperative hemorrhage requiring blood transfusions.[21,27,30,42]

Postoperative Complications

Genital Complications

A modest percentage of patients are affected by stenosis of their introitus (mean = 12%, range = 1.2–15%) or neovagina (mean = 7%, range = 1–12%) after vaginoplasty.[21,27,30,42,43] A regimen of postoperative prophylactic dilation is crucial to minimize the development of these outcomes including their worst iterations, complete atresia of the introitus or entire neovagina. Stenosis is often treated with dilation. Minor surgical revision with U-shaped introitoplasty or relaxing incisions could be necessary for recalcitrant cases.[27] Complete neovaginal atresia is very rare and requires a secondary intestinal vaginoplasty.

Rectovaginal fistulas represent the other end of the spectrum of vaginoplasty complications. They complicate only approximately 1% (range = 0–17%) of cases but represent a distressing outcome for patients and their surgeons.[8,30,44] In the largest published series of neovaginal fistulas in transgender women after GCS, van der Sluis et al[44] investigated the characteristics of 13 rectovaginal fistulas in a cohort of 1,082 patients. Every patient presented with foul-smelling discharge or passage of flatus and/or feces from her neovagina, often immediately after removing the neovaginal stent placed during surgery. They identified several factors associated with rectovaginal fistula development. Rectal injuries were an expected culprit because they compromise rectal wall integrity. Fistulas also were more common after revision vaginoplasty (6.3%) compared with primary intestinal vaginoplasty (0%) or PIV (0.8%) or when the postoperative course was complicated by hematoma, abscess, or flap necrosis.[44] These findings could support a theory proposed by Selvaggi and Bellringer[15] that the anterior rectal wall can be devascularized during dissection of the neovaginal space, compromising the tissue and lowering the threshold for a fistula to develop. Resolution of a rectovaginal fistula usually requires surgery, including

fistulectomy with primary repair, the use of local advancement flaps, or, less commonly, bowel diversion.[44] Small fistulas can resolve with conservative management including a low residue diet.

Extensive necrosis of the neovagina, labia, or neoclitoris can occur but is infrequent because pelvic structures are generously vascularized. Minor wound dehiscence is known to be extremely common in the immediate postoperative period and is likely under-reported in the literature. Minor tissue necrosis can be managed conservatively with local wound care. Surgical debridement is rarely necessary.[28] Erogenous sensation is usually conserved after partial neoclitoral necrosis because it revascularizes with time. Orgasm might be possible after neoclitoral necrosis with complete neurovascular loss by stimulating the prostate and residual erectile tissue within the corpus spongiosum.[28]

Urinary Complications

A misdirected urinary stream is the most common urinary side effect of vaginoplasty, affecting 5.6% to 33% of patients.[8,21,24,30] Meatal stenosis presents with a spraying urinary stream, obstructive voiding symptoms, or urinary retention and can be corrected with a simple meatoplasty, rearranging tissue as necessary to produce a patent, unobstructed meatus. Perioperative urinary retention is temporary and treated by replacing a urethral catheter or placing a suprapubic tube.[21] After vaginoplasty a small percentage of patients develop transient or persistent urinary incontinence (stress, urge, or mixed) or other lower urinary tract symptoms.[1,46,47] Neither the internal nor the external urinary sphincter is directly compromised during vaginoplasty, so 1 theory is that stress incontinence results from damage to the external sphincter complex during dissection of the neovaginal space.[46] The authors postulate that urinary symptoms also could be affected by a positional change in the bladder, underlying detrusor overactivity that is unmasked when the urethra is shortened, or development of periurethral fibrosis.

Hematologic Complications

Venous thromboembolic events are a feared complication of vaginoplasty because several hours of surgery are performed with the patient in lithotomy and followed by several days of decreased ambulation. Because of thrombosis prophylaxis strategies, including unfractionated or low-molecular-weight heparin, pneumatic compression stockings, discontinuing estrogen therapy perioperatively, and encouraging smoking cessation, the risk of venous thromboembolic events has been decreased to less than 1%.[3,15,21,24,26,30]

Clinically significant bleeding occurs in 1.7% to 10% of cases and commonly arises from the corpus spongiosum.[15,21,26,30,41] Fewer than 5% of patients require blood transfusions.[21,26,27,40–42,45] A perineal pressure dressing applied at the completion of surgery helps avoid postoperative hemorrhage. Large labial hematomas should be drained to prevent abscess formation and wound dehiscence.[15]

SEXUAL FUNCTION AFTER VAGINOPLASTY

Human sexual function is incompletely understood and complex and affected by countless organic and external factors. As a result, objectively defining what constitutes satisfactory sexual function can be problematic. The goal of feminizing GCS is to create a neovagina with sexual function that mirrors that of a biologic woman with adequate dimensions for penetrative intercourse, a sensate neoclitoris capable of sexual arousal and orgasm, and a cosmetically feminine vulva. Postoperative patient satisfaction is high for many, but not all, of these objectives.[3,8,27] Surgeons should discuss these limitations with patients and provide them with realistic expectations for postoperative sexual function. The optimal vaginoplasty technique with regard to sexual function outcomes has not been determined, although based on available data no approach appears obviously inferior. Referral to a pelvic floor physical therapist can aid in recovery and improve sexual functioning after vaginoplasty.

Areas of Higher Patient Satisfaction

Overall Sexual Function

Most patients are sexually active (mean = 71%, range = 33−89%) and subjectively satisfied with their sexual function after feminizing vaginoplasty.[3,27,30−32] Hess et al[2] found that 91.4% of patients who responded to a questionnaire were very satisfied (34.4%), satisfied (37.6%), or mostly satisfied (19.4%) with their sexual function after PIV. 2 studies of patients who had undergone intestinal vaginoplasty yielded similar results. Patients rated their neovaginal sexual function after primary and secondary intestinal vaginoplasty with an average score of 8.0 (range = 1−10) and 7.3 ± 1.8 (range = 1−10), respectively.[3,32] The generally high scores described in these studies are interesting to consider in the context of other measures used to report sexual function after vaginoplasty. For example, the Female Sexual Function Index (FSFI) is a validated questionnaire used to assess female sexual function; a score lower than 26.55 is considered the cutoff for sexual dysfunction.[48,49] The same transgender women who subjectively rate their sexual function favorably after vaginoplasty have FSFI scores that are consistently below the 26.55 threshold (Table 4).[3,31,32] This discordance suggests that traditional measures of female sexual function, such as the FSFI, which was validated in a cohort of biologic women who were sexually active on a regular basis within stable heterosexual relationships, should be taken with a grain of salt when applied to transgender women after vaginoplasty.

Vaginal Dimensions

Having the deepest feasible neovagina is a major concern for many patients.[28] To accommodate penetration comfortably, neovaginal width and depth should be at least 3 and 10 cm, respectively.[17] These dimensions can almost always be achieved during vaginoplasty. To maintain neovaginal size, regular dilation or penetrative intercourse is critical, especially in the 1st postoperative year.[1] Fortunately, 76% to 100% of patients are satisfied with their neovaginal depth for intercourse.[3,30,31,41] Reports of secondary procedures to increase neovaginal depth are uncommon.

Orgasm

The ability to reach orgasm is another important measure of sexual function after feminizing GCS. As the surgical technique for clitoroplasty has been refined, rates of orgasm have increased and are generally higher than 80% in contemporary studies (range = 29−100%).[2,8,24,30,32,35−37] Interestingly, 25% to 46.9% of patients report improved orgasms after vaginoplasty.[31,32]

Cosmesis

78% to 100% of patients are satisfied with the esthetic outcome of surgery.[2,31,32,41] Vaginoplasty patients graded the appearance of their genitals with an average score of 7.9 ± 1.5 (range = 4−10) in 1 study.[31] In fact, the vaginoplasty cohort scored higher than biologic women on most domains of the Female Genital Self-Imaging Scale, including for the questions "I feel positively about my genitals" and "I am satisfied with my appearance of my genitals."[31] Bouman et al[32] reported patients' median score for their esthetic outcome after intestinal vaginoplasty was 8.0 (range = 3−10). In another study of 94 vaginoplasty patients, only 2 reported being dissatisfied and 1 reported being very dissatisfied with the appearance of their genitals after surgery.[2] The positive perception most patients have about their esthetic appearance after vaginoplasty is encouraging, but there is still opportunity for improvement because a reported 25% to 80% of patients undergo secondary cosmetic procedures, usually minor labioplasty, after vaginoplasty.[3,21,26,30,43]

Areas of Lower Patient Satisfaction

Lubrication

Most vaginoplasty patients will require additional lubrication for sexual intercourse.[5,8,17,35,50] In biologic women sexual

Table 4. Sexual function after vaginoplasty[3,21,32]

	Penile inversion vaginoplasty	Primary intestinal vaginoplasty	Secondary intestinal vaginoplasty
Patient's subjective sexual function rating	Mean 7.7 ± 1.9 (1−10)	Median 8.0 (1−10)	Mean 7.3 ± 1.8 (1−10)
Female Sexual Function Index score	18.7 ± 10.8	17.5 ± 11.5	24.0 ± 10.8

arousal leads to pelvic vasocongestion and transudation of interstitial fluid through epithelial cells lining the vagina. This fluid lubricates the vaginal mucosa, protecting it from friction-related injuries and pain during penetration.[51] By contrast, a neovagina lined with keratinized penoscrotal skin cells typically does not become lubricated to the same degree. Buncamper et al[31] found the mean FSFI score for vaginal lubrication after PIV in 49 patients was 2.8 ± 2.4. When only sexually active patients in the cohort were considered, the mean FSFI lubrication score increased to 3.9 ± 1.9. An advantage of intestinal vaginoplasty is that bowel mucosa is self-lubricating, a property that was reflected in FSFI lubrication scores that increased to 4.0 ± 2.6. All vaginoplasty scores were still well below of the average FSFI lubrication score for biologic women (5.7 ± 1.0).[31,32]

Dyspareunia

Rates of dyspareunia vary widely in the literature, from 0% to 24.7%.[27,30] Mean reported FSFI scores for comfort during intercourse after PIV (2.2 ± 2.7), primary intestinal vaginoplasty (2.0 ± 2.1), and secondary vaginoplasty (3.5 ± 2.2) are lower than those of biologic women with normal sexual function (5.7 ± 0.8).[3,31,32]

CONCLUSION

Comprehensive gender dysphoria treatment often requires GCS in addition to cross-sex hormone therapy, social gender transition, and psychotherapy. GCS alleviates gender dysphoria and improves the lives of appropriately selected patients. This article is the 2nd in a 3-part series. Part 1 included a review of the non-operative management of gender dysphoria.[4] In this section, the authors outlined surgical eligibility criteria, factors associated with regret, and the ways transgender men and women benefit from GCS before focusing on feminizing vaginoplasty including a description of the authors' technique for PIV. Most GCS surgeons have gravitated toward using PIV for primary procedures and intestinal vaginoplasty for secondary procedures. The 2 techniques are safe and associated with high patient satisfaction with postoperative sexual function. Part 3 emphasizes masculinizing GCS and a discussion of the ancillary procedures and services used to treat gender dysphoria.

Corresponding Author: Miriam Hadj-Moussa, MD, Department of Urology, University of Michigan, 1500 East Medical Center Drive, TC 3884, Ann Arbor, MI 48109, USA. E-mail: mhadjmou@med.umich.edu

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STATEMENT OF AUTHORSHIP

Category 1

(a) Conception and Design
Miriam Hadj-Moussa; Dana A. Ohl; William M. Kuzon, Jr

(b) Acquisition of Data
Miriam Hadj-Moussa; Dana A. Ohl; William M. Kuzon, Jr

(c) Analysis and Interpretation of Data
Miriam Hadj-Moussa; Dana A. Ohl; William M. Kuzon, Jr

Category 2

(a) Drafting the Article
Miriam Hadj-Moussa; Dana A. Ohl; William M. Kuzon, Jr

(b) Revising It for Intellectual Content
Miriam Hadj-Moussa; Dana A. Ohl; William M. Kuzon, Jr

Category 3

(a) Final Approval of the Completed Article
Miriam Hadj-Moussa; Dana A. Ohl; William M. Kuzon, Jr

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Appendix A. Surgical procedure for penile inversion vaginoplasty

Positioning and patient preparation

Patient is positioned in lithotomy. SCDs and SQH 5,000 U are given for thrombosis prophylaxis. IV prophylactic antibiotics are administered. Surgical field is prepared with a povidone-iodine solution from the umbilicus to the knees, including the buttocks. A urethral catheter is placed.

Harvest skin flaps and grafts

Posteriorly based perineal skin flap

Starting 2 cm above the anus, mark and raise a trapezoidal perineal skin flap with a 3.5- to 4-cm-wide base, tapering to 3.0- to 3.5-cm wide where the perineum meets the scrotum. The flap's vertical distance is variable, depending on length of the patient's perineum.

Full-thickness scrotal skin graft

A 10-cm-wide × 5-cm-long rectangle of scrotal skin abutting the superior border of the perineal skin flap is raised sharply. On the back table, the scrotal skin graft is aggressively defatted and shaped around a vaginal stent to form the neovaginal apex.

Anteriorly based penile skin flap

A vertical incision is extended ventrally along the midline raphae from the superior edge of the scrotal skin flap to the mid-shaft of the penis, leaving a few centimeters of an intact circumferential skin tube around the distal aspect of the penis.

Develop neovaginal space

Develop ischioanal fossae

The bulbospongiosus' attachments to the perineal body are divided, mobilizing the urethra. To access the ischioanal fossae, the perineal membrane is nicked to the right and left of the perineal body and the space is bluntly dissected. Bilateral superficial perineal muscles traveling horizontally and inserting into the perineal body are isolated, ligated by suture, and divided.

Develop rectovesical space

While applying gentle downward traction on the rectum, sharply divide the rectourethralis, which tents the anterior wall of the rectum to the apex of the perineal body, and fibers from the membranous urethra. Dissection proceeds sharply using the Foley catheter as a guide until the apex of the prostate is palpated. Then, blunt dissection is carried out along a relatively avascular perirectal fat plane anterior to the Denonvilliers rectoprostatic fascia, which remains draped over the rectum. The Denonvilliers fascia has attachments at the base of the prostate that might need to be sharply divided so the dissection can be carried out to the level of the peritoneal reflection. The authors do not routinely incise the levator muscles to widen the neovaginal space.

Check for a rectal injury by placing a clean lap sponge in the neovaginal space and instilling 50% povidone-iodine solution 60 mL into the rectum. A rectal injury has occurred if any povidone-iodine is seen on the lap sponge when it is removed from the neovaginal space. A bimanual examination with 1 finger in the rectum and another in the neovaginal space also confirms intact rectal mucosa.

Bilateral orchiectomy

Each spermatic cord is ligated by suture at the level of the external inguinal ring so the stumps retract into the inguinal canal and are not palpable in the groin.

Deglove penis and release attachments

Mark and incise a circumferential incision approximately 3 cm from the corona. Deglove the penis, leaving the Buck fascia intact. The distal penile shaft skin will be used to construct the clitoral hood and labia minora. Remaining close to the inferior pubic ramus, divide the fundiform and deep suspensory ligaments on the dorsal aspect of the penis. The decussation of the crura is visible once the suspensory ligament is divided.

Raise the dorsal neurovascular bundle and neoclitoris

Starting on the lateral aspect of each corporal body, develop a plane between the Buck fascia and the tunica albuginea and raise the dorsal NVB. Carry the dissection proximally until the NVB is released from the corpora as it decussates and distally to the level of the glans. On the dorsal glans, mark a triangle with a 1-cm-wide base at the corona. Incise the glans and dissect deeply to expose the tips of the corpora. Preserve the maximum amount of glanular erectile tissue on the neoclitoris.

Penile disassembly

Separate the corpus spongiosum from the corporal bodies. Amputate each corporal body at the level of the pubis and over-sew to maintain hemostasis.

(continued)

Appendix A. Continued

Prepare the urethra	
Resect the bulbospongiosum off the bulbar urethra. Transect the pendulous urethra, leaving adequate length for the dorsal aspect to line the vestibule between the neomeatus and neoclitoris. Excise spongiosum from the ventral aspect of the bulbar urethra to minimize engorgement during sexual arousal, which can cause narrowing of the neovagina and dyspareunia.	
Raise suprapubic advancement flap	
To minimize upward tension on the penile skin flap positioned within the neovaginal space, it is mobilized by raising an advancement flap from the mons and suprapubic skin. Place 2 closed-suction drains, 1 in the lower abdomen under the advancement flap and the other adjacent to the rectum and neovagina. The neovaginal space drain should be observed carefully for the presence of feculent material, which would indicate a rectal leak.	
Position neoclitoris	
Tack down tissue surrounding the dorsal NVB underneath the suprapubic advancement flap so that when the NVB is folded toward the perineum, there is no twisting or kinking of its pedicle and the neoclitoris is positioned ~1 cm inferior to the pubic arch.	
Labioplasty	
Secure skin from each penoscrotal junction to its corresponding corner at the base of the perineal skin flap to form the labia majora. A minor excision of skin is usually necessary to achieve a suitable contour. Close skin edges.	
Create window for neoclitoris and neomeatus	
Position the invaginated penile skin tube within the neovaginal space. Make a V-shaped incision over the impression made by the neoclitoris under the skin. Extend the window with a vertical incision toward the rectum to accommodate the meatus. Release the penile skin flap and pass the urethra and Foley catheter through the window. Replace the penile skin flap within the neovaginal space.	
Clitoroplasty	
Use a square stitch on the clitoris' ventral aspect to produce a conical shape. To construct the clitoral hood, suture the distal penile shaft skin to the edges of the clitoral window. The clitoral hood retracts postoperatively to adequately expose the neoclitoris.	
Meatoplasty	
The urethra is trimmed to a length that reaches the neoclitoris. Suture the distal aspect of the dorsal urethral plate to the posterior margin of the neoclitoris. Spatulate the ventral urethra so the apex of the meatus is positioned 2—3 cm below the neoclitoris and suture an urethrocutaneous anastomosis.	
Line neovagina	
Inset the trapezoidal perineoscrotal skin flap into a midline incision of the penile skin tube; this serves to widen the neovaginal introitus. If a skin graft is being used to lengthen the neovagina, suture it to the end of the penile skin tube; otherwise, close the apex of the penile skin tube with absorbable suture. Position the tubularized perineoscrotal flap, penile skin flap, and any scrotal skin graft into the neovaginal space. The neovaginal lining should be held in position for 5 days. This can be accomplished with a bolstered vaginal packing (our preference) or with a Silastic neovaginal stent.	

SCDs = sequential compression devices; SQH = subcutaneous heparin; IV = intravenous; NVB = neurovascular bundle.